SECTION 1 INTRODUCTION

This report is required by Sections 8002(f) and (p) of the Resource Conservation and Recovery Act (RCRA), which directs the Environmental Protection Agency (EPA) to perform studies of wastes generated in the mining, beneficiation, and processing of ores and minerals and to report the results of these studies to Congress. This report is based on literature reviews and contractor studies, including numerous analytical testing results on the wastes. EPA's RCRA Docket contains copies of the source materials that the Agency used in preparing this report.

Because Congress has amended the Act several times in ways that changed the requirements for mining wastes, and because EPA regulations continue to evolve both in response to legislation and as EPA collects additional information, a brief legislative and regulatory history provides a useful context for this Report to Congress.

When first enacted in 1976 (P.L. 94-580), RCRA contained a broad definition of solid waste that included "solid, liquid, semi-solid, or contained gaseous material resulting from...mining...operations." [emphasis added] (Section 1004(27)).

Section 8002(f) of the original Act directed EPA to conduct a

> detailed and comprehensive study on the adverse effects of solid wastes from active and abandoned surface and underground mines on the environment, including, but not limited to, the effects of such wastes on humans, water, air, health, welfare, and natural resources, and on the adequacy of means and measures currently employed by the mining industry, Government agencies, and others to dispose of and utilize such solid wastes to prevent or substantially mitigate such adverse effects.

The study was to include an analysis of:

1. The sources and volume of discarded material generated per year from mining;

2. Present disposal practices;

3. Potential danger to human health and the environment from surface runoff of leachate and air pollution by dust;

4. Alternatives to current disposal methods;

5. The cost of those alternatives in terms of the impact on mine product costs; and

6. Potential for use of discarded material as a secondary source of the mine product.

The Act did not specify a date for the completion of this study.

On December 18, 1978, EPA proposed regulations to implement Subtitle C of RCRA, including rules for identifying and listing hazardous wastes and for managing these wastes. Based on the language in the House Committee Report accompanying the House Bill, which was the predecessor to the Act, EPA specifically excluded as a hazardous waste "overburden resulting from mining operations and intended for return to the mine site" unless the overburden was specifically listed. The Agency proposed to list waste rock and overburden from uranium mining and overburden and slimes from phosphate surface mining because of concern about their radioactivity. The proposal also considered any other mining wastes that were ignitable, corrosive, reactive, or EP toxic as hazardous waste.

In addition, the proposal included distinct management standards for "special wastes," which "occur in very large volumes" and for which "the potential hazards...are relatively low" (43 FR 58992, December 18, 1978). The Agency proposed less stringent standards for these wastes than for other

hazardous wastes, pending the development of additional information and a subsequent planned rulemaking. Certain mining wastes were among the special wastes. They included phosphate mining, beneficiation, and processing wastes; uranium mining waste; and other mining waste that was ignitable, corrosive, reactive, or EP toxic.

On May 19, 1980, EPA promulgated interim final regulations implementing Subtitle C of RCRA. The Agency retained the exclusion for overburden that was returned to the mine site; however, the Agency dropped the two proposed listings, because the regulations "eliminated the part of the proposed exemption that would. allow exempted overburden to be brought within RCRA jurisdiction through specific listing as a hazardous waste" (45 FR 33100, May 19, 1980). EPA also promulgated interim final listings for three specific mining waste streams: (1) flotation tailings from selective flotation from mineral metals recovery operations, (2) cyanidation wastewater treatment tailings pond sediment from mineral metals recovery operations, and (3) spent cyanide bath solutions from mineral metals recovery operations. Before the first of these listings became effective, however, EPA withdrew this listing based on technical comments from the regulated community.

These promulgated standards did not have distinct and less stringent management standards for mining wastes. Between the time of the proposal and the promulgation of the interim final rule, EPA modified the EP toxic and corrosivity criteria for hazardous wastes, and the Agency therefore anticipated that a smaller quantity of mining wastes would be classified as hazardous based on results of tests for these two characteristics. However, EPA judged that wastes so classified would clearly exhibit sufficient toxicity to be of concern. "Thus the concern over the inapplicability of the proposed

regulations to hazardous special wastes, due to the potentially large volume and low level of hazard of these wastes, is not a valid concern in the final regulations" (45 FR 33174, May 19, 1980). The preamble also noted that there was no current provision that would permit deferring the regulation of mining wastes until the results of the Section 8002(f) study were available. EPA did point out, however, that Congress was considering legislation that would amend RCRA to require deferral until the study was complete.

Congress then amended RCRA in the Solid Waste Disposal Act of 1980 (P.L. 96-482), enacted on October 21, 1980. Among other things, the amendments prohibited EPA from regulating solid waste from the "extraction, beneficiation, and processing of ores and minerals, including phosphate rock and overburden from the mining of uranium ore" as hazardous wastes under Subtitle C of RCRA until at least 6 months after the Agency completed and submitted to Congress the studies required by Section 8002(f) and by a new section, 8002(p).

Section 8002(p) requires EPA to perform a comprehensive study on the disposal, and utilization of solid waste from the extraction, beneficiation, and processing of ores and minerals, including phosphate rock and overburden from uranium mining. This new study, to be conducted in conjunction with the study of mining wastes required by Section 8002(f), mandated an analysis of:

1. The source and volumes of such materials generated per year;

2. Present disposal and utilization practices;

3. Potential danger, if any, to human health and the environment from the disposal and reuse of such materials;

4. Documented cases in which danger to human health or the environment has been proven;

5. Alternatives to current disposal methods;

6. The costs of such alternatives;

7. The impact of these alternatives on the use of phosphate rock and uranium ore, and other natural resources; and

8. The current and potential utilization of such materials.

The amendments also required the Administrator, "after public hearings and opportunity for comment, either to determine to promulgate regulations" for mining wastes or "to determine that such regulations are unwarranted." These determinations must be published in the Federal Register.

Finally, the amendments specified that EPA could control radiation exposures caused by mining wastes under RCRA. Section 3001(b)(3)(B)(iii) authorized the Administrator to

> prescribe regulations. ..to prevent radiation exposure which presents an unreasonable risk to human health from the use in construction or land reclamation (with or without revegetation) of (I) solid waste from the extraction, beneficiation, and processing of phosphate rock or (II) overburden from the mining of uranium ore.

On November 19, 1980, EPA published an interim final rule to implement the 1980 RCRA Amendments. Specifically, EPA excluded from regulation under Subtitle C of the Resource Conservation and Recovery Act "... solid waste from the extraction, beneficiation and processing of ores and minerals (including coal), including phosphate rock and overburden from the mining of uranium ore" (45 Fed. Reg. 76618, codified at 40 CFR 261.4(b)(7)). The Agency interpreted the scope of the exclusion very broadly:

> Until the Agency takes further rulemaking action on this matter, it will interpret the language of today's amendments, with respect to the mining and mineral processing waste exclusion, to include solid waste from the exploration, mining, milling, smelting and refining of ores and

> minerals. This exclusion does not, however, apply to solid wastes, such as spent solvents, pesticide wastes, and discarded commercial chemical products, that are not uniquely associated with these mining and allied processing operations (45 FR 76619, November 19, 1980).

EPA solicited public comment on its interpretation to assist in determining the appropriate scope of the statutory exclusions.

> In particular, EPA questions whether Congress intended to exclude (1) wastes generated in the smelting, refining and other processing of ores and minerals that are further removed from the mining and beneficiation of such ores and minerals, (2) wastes generated during exploration for mineral deposits, and (3) wastewater treatment and air emission control sludges generated by the mining and mineral processing industry. EPA specifically seeks comment on whether such wastes should be part of the exclusion. EPA also seeks comment on how it might distinguish between excluded and non-excluded solid wastes (45 FR 76619, November 19, 1980).

The Hazardous and Solid Waste Amendments of 1984, enacted in November of that year as P.L. 98-616, represent the culmination of the House and Senate reauthorization hearings begun in early 1983. Of chief concern to the mining industry are amendments that provide EPA flexibility in applying bans on land disposal and certain requirements for obtaining permits under Subtitle C of RCRA to the mining industry.

The amended statute provides, under Section 3004(x), that if mining wastes become subject to regulation as hazardous wastes under Subtitle C, the Administrator of EPA, in promulgating regulations, is authorized to modify the requirements of subsections (c), (d), (e), (f), (g), (o), and (u) of Section 3004 and subsection 3005(j), which relate to:

1. Liquids in landfills,
2. Prohibitions on land disposal,
3. Solvents and dioxins,
4. Disposal into deep injection wells,

5. Additional land disposal prohibition determinations,

6. Minimum technological requirements,

7. Continuing releases at permitted facilities, and

8. Interim status surface impoundments.

The Administrator is authorized to take into account the special characteristics of mining and beneficiation wastes, "the practical difficulties associated with implementation of such requirements, and site-specific characteristics, including, but not limited to, the climate, geology, hydrology, and soil chemistry at the site, so long as such modified requirements assure protection of human health and the environment."

The Conference Report accompanying H.R. 2867 (which in its final amended form was passed by both Houses of Congress as P.L. 98-616) provides clarification:

> This Amendment recognizes that even if some of the special study wastes [which include mining wastes as specified in Sections 8002 (f) and (p)] are determined to be hazardous it may not be necessary or appropriate because of their special characteristics and other factors, to subject such wastes to the same requirements that are applicable to other hazardous wastes, and that protection of human health and the environment does not necessarily imply the uniform application of requirements developed for disposal of other hazardous wastes. The authority delegated to the Administrator under this section is both waste-specific and requirement-specific. The Administrator could also exercise the authority to modify requirements for different classes of wastes. Should these wastes become subject to the requirements of Section 3005 (j), relating to the retrofit of surface impoundments, the Administrator could modify such requirements so that they are not identical to the requirements that are applied to new surface impoundments containing such wastes. It is expected that before any of these wastes become subject to regulations under subtitle C, the Administrator will determine whether the requirements of Section 3004 (c), (d), (e), (f), (g), (o), and (u), and Section 3005(3) should be modified [H.R. Report 98-1133, pp. 93-94, October 3, 1984].

On October 2, 1985, EPA proposed (50 Fed. Reg. 401292) to reinterpret the scope of the mining waste exclusion as it applies to processing wastes,

leaving within it only large-volume processing wastes, such as slag from primary metal smelters and elemental phosphorus plants, red and brown muds from bauxite refineries, and phosphogypsum from phosphoric acid plants. Those other wastes from processing ores and minerals that are hazardous would be brought under full Subtitle C regulation after the promulgation of the reinterpretation, and would therefore not be included in the scope of a subsequent Report to Congress on processing wastes. The large-volume processing wastes that remain within the exclusion would be studied and a Report to Congress prepared to complete EPA's response to the RCRA Section 8002(p) mandate.

Thus, EPA must submit a Report to Congress under RCRA Sections 8002(f) and (p) and then publish its findings in the Federal Register before any waste covered by the mining exclusion can be regulated under Subtitle C of RCRA. No such restrictions, however, apply to wastes not included within the scope of the exclusion.

1.1 SCOPE

This report addresses waste from the mining and beneficiation of metallic ores, with special emphasis on copper, gold, iron, lead, molybdenum, silver, and zinc; uranium overburden; and the nonmetals asbestos, phosphate rock, and oil shales. (Appendix A to this report addresses wastes from the mining and beneficiation of oil shales.) EPA selected the mining industry segments to be covered in this report on the following basis. First, the Agency excluded wastes that are the primary responsibility of other regulatory agencies. Thus, this report does not address uranium mill tailings or the mining and beneficiation of coal. The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) (P.L. 95-604) requires proper disposal of "residual radioactive

material," including mill tailings and residual stocks of unprocessed ores or low-grade materials. UMTRCA directed EPA to prepare a Report to Congress on uranium mill railings, and the Agency has done so.[1] Under UMTRCA, EPA determines "standards of general application," and the Nuclear Regulatory Commission writes the implementing regulations and enforces them for active mills. Uranium mill tailings are defined as "byproduct material" by the Atomic Energy Act and, as such, do not constitute a "solid waste" as defined by RCRA Section 1004(27). Therefore, they are not subject to RCRA requirements.

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) (P.L. 95-87) applies to surface coal mining reclamation activities. Under RCRA, the Administrator of EPA must review any regulations under SMCRA that are applicable to coal mining wastes and overburden. However, the Secretary of the Interior, with concurrence from the Administrator of EPA, is responsible for promulgating regulations that effectuate the purposes of Subtitle C of RCRA with respect to "coal mining wastes or overburden for which a surface coal mining and reclamation permit is issued or approved under the Surface Mining Control and Reclamation Act of 1977."

The Agency also excluded from the scope of this report wastes generated in the processing of ores or minerals. EPA will address large-volume wastes (such as slag and phosphogypsum) generated by these processes in a subsequent report. EPA will also evaluate other nonmetal mining wastes (in addition to asbestos and phosphate) and wastes from inactive or abandoned mines at a later time.

1.2 CONTENTS

This report consists of seven sections and four appendices. The following paragraphs briefly discuss each of the remaining sections of the report.

Section 2, OVERVIEW OF THE NONFUEL MINING INDUSTRY,[2] presents a summary of the mining and beneficiation of ores and minerals and provides information on the number of mines, their geographic distribution, and the quantity of waste generated in mining and beneficiation.

Section 3, MANAGEMENT PRACTICES FOR MINING WASTES, provides an overview of the mining waste management process and discusses specific waste management practices and mitigative measures for the land disposal of mining waste. For some segments of the industry, the section provides information on the proportion of mine facilities that currently practice these mitigative measures.

Section 4, POTENTIAL DANGER TO HUMAN HEALTH AND THE ENVIRONMENT, presents information on the characteristics of the wastes that pose a potential threat to human health and the environment. It estimates how much mining industry waste would fail current RCRA hazardous waste characteristics, and how much would be hazardous under an augmented set of characteristics. It then provides the results of EPA's monitoring of ground water at selected sites. It also discusses the structural stability of impoundments used to manage mining waste. Next, it presents damage cases. Finally, it describes how risk analysis could be used to quantify the effects that current and alternative practices have on human health and the environment.

Section 5, THE ECONOMIC COST OF POTENTIAL RCRA WASTE MANAGEMENT, first presents the methodology EPA used to determine the potential cost of regulating mining wastes under RCRA, using four different regulatory scenarios

and two different sets of hazard criteria. The section then presents the results of the analysis in terms of total potential costs, the potential costs to various mining sectors, and the potential costs to the affected mines.

Section 6, CONCLUSIONS AND RECOMMENDATIONS, summarizes the conclusions reached in the other sections of the report and presents EPA's recommendations.

Section 7, SELECTED BIBLIOGRAPHY, lists the sources that were used in this report as well as some references that contain valuable information related to mining waste.

This report also contains four appendices:

* Appendix A, SUMMARY OF MAJOR WASTES FROM THE MINING AND PROCESSING OF OIL SHALES, summarizes a report on high-volume wastes generated by the mining and processing of oil shales. This information was not included in this Report to Congress because the United States oil shale industry is not yet operating on a commercial scale. The entire oil shale report is available in the EPA docket.

* Appendix B, METHODOLOGY, describes the methodology used by EPA to assess current industry waste management practices and to estimate the amount of hazardous mining waste generated annually.

* Appendix C, SELECTED CRITERIA ANALYZED FOR TOXIC EFFECTS, contains tables comparing levels of metals measured by the EP toxicity test allowed by various EPA standards and criteria; tables on arsenic, cadmium, chromium, lead, mercury, selenium, and cyanide toxicity to aquatic biota are also included. In addition, this appendix summarizes radiation effects and effects of asbestos exposure on various biological species, and the effects of decreasing pH on fish.

* Appendix D, GLOSSARY, provides definitions of mining-related and other technical terms referred to in the text.

SECTION 1 FOOTNOTES

1 US EPA 1983a.

2 For the purposes of this report, the nonfuel mining industry is defined as including uranium although processed uranium may be used as fuel.